CHAPTER 3

RESEARCH METHODOLOGY

3.1. Introduction

The survey study was designed to assess the level of environmental awareness, knowledge and attitude among secondary school students in Melaka towards tropical rainforest issues. The study also assessed students' reading or watching environmental programme habit and involvement in environmental activities. It aimed to identify any significant differences and relationship between students reading or watching environmental programme habit, students involvement in environmental activities, students level of environmental awareness, knowledge and attitude towards tropical rainforest issues with gender (female and male), forms (form 1 and form 4) and locations of schools (urban and rural).

3.2. Pilot Test

3.2.1. Instrumentation

The survey study was conducted through a survey questionnaire containing 60 questions. The survey questionnaire (see appendix B) was formulated into four sections:

a) **Section A**: General information of the students

This section consisted of information such as students' name, gender, location of school, students' reading or watching environmental programme habit (e.g. television, video, etc) and involvement in environmental activities

b) **Section B**: Awareness Test on Tropical Rainforest Issues

This section contained 20 questions testing on students' awareness on various rainforest issues in Malaysia. Most of the rainforest issues tested were based on students' general knowledge; knowledge obtained through students' wide reading or watching environmental programme and interest on the issue. Among the issues tested were forest value, forestry laws and policies, forest management, mitigation actions and forest development issues in Malaysia. The questions were formulated as multiple-choice questions with 4-answer options.

c) **Section C**: Knowledge Test on Tropical Rainforest Issues

This section contained 20 general knowledge questions on tropical rainforest issues. Most of these information are taught in the school education syllabus. The questions formulated involved knowledge on the basic characteristics of the tropical rainforest, the function of the rainforest, the causes and effect of deforestation. The questions were formulated as multiple-choice questions with 4-answer options.

d) **Section D**: Attitudes towards Tropical Rainforest Issues.

This final section consisted of 20 statements to which students were requested to respond to either one of the five responses: "Strongly Agree", "Agree", "No Comment", "Disagree" or "Strongly Disagree". These statements were formulated to test students' attitude and commitment towards conserving and preserving the tropical rainforest.

3.2.2. Validity and Translation of the Revised Version of the Questionnaire

To ascertain the validity of the questionnaire, two experts who are competent in the field were consulted. The expert is an academician from University Malaya who has more than 10 years experience and another was a Forestry Officer in the Malaysian Nature Society with more than 5 years experience.

The English version of the questionnaire was translated into a Malay version (see appendix B) and given to the students. The Malay language is the main language used in the Malaysian education system. Two government school teachers, who are competent in both languages, checked the translation to ensure that the questionnaire was accurate and could be understood by the students. Both teachers have more than 10 years of teaching experience and are active School Nature Club teacher advisors.

3.2.3. Respondents of the Study

The translated Bahasa Malaysia questionnaire was pilot tested on 30 form One and 30 form 4 students from a school in the Alor Gajah district of Melaka in July 2001. The purpose of the pilot test was to ensure the clarity and applicability of the questionnaire for the true sampling study.

The school teachers were given the responsibility to select the students for the test. The respondents were well represented, taking students from the first to the last class in both forms. Students taking Biology and General Science subjects also represented form 4 students. Students were mostly taught and exposed to tropical rainforest issues through Geography and Biology lessons.

3.2.4. Administration of Test

Each student was given a set of question paper and a set of answer sheet. Students were to hand in both the question and answer papers at the end of the test.

The researcher gave a brief introduction to the students on the questionnaire and the objectives of the survey. Students were given an hour to complete the pilot test questionnaire. The test was conducted during school hours with the permission of the school principal and class teachers.

At the end of the pilot test, the researcher conducted a survey to get students comments on the questionnaire. Generally, students were able to complete the questionnaire within the one hour given. However, students commented that the language used in certain questions were technical and difficult. On the other hand, some questions in Section B which tested on students awareness on tropical rainforest issues were challenging especially among the form 1 students as it involved general knowledge. Therefore, the pilot test questions were analyzed statiscally and only fifteen were selected for the true sampling for both sections B and C. The terms and language used were also simplified accordingly so that students could better understand the questionnaire.

3.2.5. Marking Scheme

Points were given to every section in the questionnaire. For Section A, points were given to the questions testing on students' reading or watching environmental programme habit and students' involvement in environmental activities. The points given were based on the 4 answer options given and points were attributed as follows :

Points	Answer Selection
4	Very often
3	Often
2	Seldom
1	Never

The minimum score for Section A was 1 and the maximum score was 4. Due to the objective structure of the questions in Sections B and C in the questionnaire, with each containing 15 questions, students were awarded with one point for every correct answer while no points were attributed for the wrong answers. The minimum score a student could achieve was 0 if a student answered all questions wrongly. On the other hand, the maximum score was 15 if a student answered all the questions correctly. This meant that, the higher the score they obtained the higher the level of environmental awareness and knowledge.

The points attributed to the answer selection in Section D that assessed students' attitude towards tropical rainforest issues were as follows:

Points	Answer Selection
4	Strongly Agree
3	Agree
2	Disagree
1	Strongly Disagree
0	No comment

Higher points were obtained when more "Strongly Agree" answers were selected. However, there were 8 negative statements and they are Question No. 4, 6, 9, 10, 11, 15, 18 and 19 where the points attributed were reversed from the above table. For these questions, the points attributed were as follows:

Points	Answer Selection
4	Strongly Disagree
3	Disagree
2	Agree
1	Strongly Agree
0	No comment

Higher points were obtained when more "Strongly Disagree" answers were selected. The minimum score for this section was 0 when a students chose the 'no comment' answer selection for all the statements given while the maximum score was 80 points when a student chose the correct answer selection ('strongly agree' answer selection for positive statements and 'strongly disagree' for negative statements).

3.2.6. Data Analysis

The main reason for the pilot test was to ascertain the applicability of the test and to select the appropriate questions for the true sample questionnaire. Therefore, no data analysis was conducted on Section A because it only contained general information of the students. The data analysis for the pilot sampling was concentrated on Sections B and C, which tested on students' environmental awareness and knowledge respectively. The data analysis for the pilot test involved the computation of mod, median, mean, standard deviation, facility index and discrimination index (refer to Section 3.3.5).

3.3. True Sampling Survey

3.3.1. Instrumentation

The survey study conducted was similar to the pilot test questionnaire. The true survey questionnaire consisted of four sections (refer to Appendix C):

a. **Section A** : General Information of the Respondents

This section consisted of information such as students' name, gender, location of school, students' reading or watching environmental programme habit (e.g. television, video, etc) and involvement in environmental activities

b. **Section B** : Awareness Test on Tropical Rainforest Issues

Fifteen questions were selected from the 20 questions surveyed in Section B during the pilot test. From the 20 questions surveyed, Questions No. 1, 2, 3, 8, 9, and 14 were not selected for the true sampling. Instead one question on ecotourism was added to this section. The questions in this section was also restructured and made simpler to ensure that the questions were suitable and easy

to understand for the true sampling respondents. The questions were formulated as multiple-choice questions with 4-answer options.

c. **Section C** : Knowledge Test on Tropical Rainforest Issues

In this section, only 15 questions were selected from the 20 questions surveyed in Section C during the pilot test. From the 20 questions surveyed in the pilot test, Questions No. 6, 12, 14, 17 and 19 were not selected for the true sampling survey. The 15 questions selected were also restructured and made simpler. The questions were formulated as multiple-choice questions with 4-answer options.

d. **Section D** : Attitudes Towards Tropical Rainforest Issues

All 20 questions were selected for the true sampling survey with some simplification of the sentences for easier understanding.

3.3.2. Respondents of the Study

The respondents of the study consisted of 255 urban and rural secondary school students who were in form 1 and form 4. The Science and Arts Stream students also represented the form 4 students. The respective school teachers were given the responsibility to select the students for the test similar to that in the pilot test survey. The respondents were well represented, taking students from the first to the last class in both forms. Students taking either the Biology or General Science subject also represented form 4 students.

Four schools were sampled for this purpose. Two schools were sampled in Melaka Tengah, which represented the urban school and two schools in Jasin district, which represented the rural school.

Although initially the study required 70 students (35 form 1 students and 35 form 4 students) for the questionnaire from each school, but at the end of the sampling process, only 268 students participated in the survey. Upon marking, only 255 answer sheets were valid for the study, as 13 answer sheets were incomplete.

3.3.3. Administration of Test

The true sampling survey was conducted about a week after the pilot test was conducted. The test was conducted during school hours with the permission of the school principal and class teachers, particularly in the late morning of the day. The four schools were sampled within a 10-day period in the month of July 2001.

Each student was given a set of question paper and a set of answer sheet. Students were to hand in both the question and answer papers at the end of the test. The researcher gave a brief introduction to the students on the questionnaire and the objectives of the survey. Students were given 45 minutes to complete the questionnaire.

3.3.4. Marking Scheme

Points were given to every section in the questionnaire. The marking scheme used in the true sampling marking scheme is similar to the pilot test sampling-marking scheme (refer to Section 3.2.5.).

3.3.5. Data Analysis

The data collected was analyzed according to the methods listed below. Section A, which tested on students' reading or watching environmental programme habit and students' involvement in environmental activities, were analyzed using the log-linear analysis due to the categorical nature of the test. On the other hand, other methods listed below were used to analyze data obtained from the test of students' level of awareness, knowledge and attitude.

i. **Mode** : It is the most frequently occurring score in the distribution.

ii. **Median** : The median is the point below which 50% of the scores lie. An approximation to that point is obtained from ordered data by simply finding the score in the middle of the distribution.

iii. **Mean** : It is the arithmetic average of a set of scores. It is found by adding all the scores in the distribution and dividing by the total number of scores.

iv. **Standard Deviation** : It is the measure of variability in a distribution. It is the square root of the variance.

v. **Difficulty Index** : The difficulty index was done to compute the ratio of students who got the item correct. The difficulty index ranges between 0.00 to 1.00. For each item, the total number of students who answered correctly was counted. The ratio of this number to the total number of students gave the difficulty index or p-value. The formula for the difficulty index is as follows:

$$\text{Difficulty Index, } p = R / T$$

where

R : number of students who answered the item correctly

T : total number of students

vi. **Discrimination Index** : The discrimination index was computed for each question. To do this, the test answer papers were arranged from the highest to the lowest score. Then, the ordered set of papers was divided into two groups; namely, those with the higher score in one group and those with the lower score in one group. For each item, the percentage of students getting the correct answers to the questions in Section B and Section C of the questionnaire was computed. Discrimination index was computed by subtracting the number of students in the lower group who answered the question correctly from the number in the upper group who got the question correct and dividing by the number of students in either group. The mathematical formula is as follows:

$$\text{Discrimination Index} = \frac{A - B}{0.5\,(n)}$$

where

A : the number of students in the upper group who got the question correct

B : the number of students in the lower group who got the question correct

n : total number of students

Scores for the discrimination index ranges from –1.00 to 1.00. If it has a positive value, the question has positive discrimination. This means that a larger proportion of the more aware or knowledgeable students got the question correct compared to less aware or knowledgeable students. If the value is zero, the question has zero discrimination. This can occur because the question is too easy or too difficult or because it is ambiguous. Hence, there is no diffrence in the number of students from both groups who answered the item correctly. If more poor students than better students get the question right, one would obtain a negative discrimination. With a small number of students, this could be a chance result, but it may indicate that the question is ambiguous or miskeyed. For the classroom test, where one divides the class into upper and lower halves, one would hope that most of the questions have discrimination indices above 0.20.

vii. **Kuder-Richardson Reliability Coefficient**: The Kuder-Richardson Reliability Coefficient is used for items that are scored dichotomously (right or wrong) or according to some other all-or-none system. It is the most common procedure for finding interim consistency, which is influenced by content sampling and heterogeneity of the behavior domain sampling.

As in the split-half methods, interim consistency is found from a single administration of a single test. This technique is based on an examination of performance on each item. The formula may be considered as representative of the average correlation obtained from all possible

split-half reliability estimates. The formula is as follow:

$$KR\ 20: \quad (n / n - 1)\ (1 - [\Sigma PQ / S^2])$$

where :

n: number of questions in the test

P: proportion of students who answered question correctly (item difficulty)

Q: proportion of students who answered the question incorrectly (Q = 1-P)

S^2: variance of the total scores on the test

The Kuder-Richardson Reliability Coefficient is actually the mean of all split-half coefficients resulting from different splitting of a test and it ranges from 0 to 1.00. The more homogeneous the domain, the higher the interim consistency.

viii. **Univariate Analysis** : The analysis of variance (ANOVA) was computed to test for significant difference between means of more than 2 groups. It is a test of significant difference between gender, between forms and between location of school through the use of analysis of variance (ANOVA). Only significant ANOVA test results ($p < 0.05$) were followed by post-hoc comparisons of the means. The post hoc test was performed based on the error terms from the respective overall analysis. For this purpose, the Newman-Keuls test was selected (Zar, 1999). The test was based on the studentized range statistic. Computationally, the programme first sorts the means into ascending order. For each pair of means, the programme then assesses the probability under the null hypothesis (no

differences between means in the population) of obtaining differences between means of this (or greater) magnitude, given the respective number of samples. Thus, it actually tests the significance of ranges, given the respective number of samples. A three-factor ANOVA was carried out to determine the influence of location of school (urban or rural), gender (female or male) and form (form 1 or form 4) on the following variables:

a. students level of environmental awareness towards tropical rainforest issues
b. students level of environmental knowledge towards tropical rainforest issues
c. students attitude towards tropical rainforest issues

ix. **Log-Linear Analysis:** Log-linear analysis provides a "sophisticated" way of looking at multiway frequency tables or crosstabulation tables (to explore the data or verify specific hypotheses), and it is sometimes considered an equivalent of ANOVA for frequency data. Specifically, it allows the test of different categorical variables that are used in the crosstabulation (e.g., gender, region, etc.) and to determine their interactions for the test of statistical significance. In this study, the response variables involved were students' reading or watching environmental programme habit and students' involvement in environmental activities. The designed variables were location of school (urban or rural), form (form 1 or form 4) and gender (female or male).

The Log-Linear module computes two types of *Chi-square*, the traditional Pearson *Chi-square* statistic and the maximum likelihood ratio

Chi-square statistic. Both tests evaluate whether the expected cell frequencies under the respective model are significantly different from the observed cell frequencies. If so, then the respective model for the table is rejected. Log-Linear module also allows the user to reproduce various plots of residual frequencies and related statistics. The *Chi-square* of models that are hierarchically related to each other can be directly compared.

In search for a 'good model' that fits the data, one can examine the logic of the automatic model fitting algorithm 'manually' by examining the k-factor interactions. For example, one can examine the table of models that include no two-way interactions, no three-way interactions. The Log-Linear module will automatically compute the results of fitting all k-factors interactions. The next step in the manual procedure would be to determine which interactions are necessary in the model to fit the data.

There are two ways in which one could proceed; both alternatives consider the interactions one by one. First, one could fit all two-way or three-way interactions except the one under consideration. If the difference between the model with and without the respective two-way or three-way interaction is significant, than that interaction would be retained in the model. This type of test is also referred to as the test for *partial association* (StatSoft, 1994). The second test that could be performed would be to compare a model without any interactions with a model including the two-way or three-way interaction under consideration. This test is referred to as the *marginal association* (StatSoft, 1994). Once the

significant interactions were identified, the next step would be to fit a model with the significant interactions.

In order to interpret the final model, the fitted (expected) frequencies in the table was examined. The interpretation of factors and their interactions is analogous to that in analysis of variance.

x. **Multivariate Analysis – Principal Components Analysis (PCA)**

Multivariate analysis refers to the statatiscal methods that simultaneously analyze multiple measurements on each individual or object of a study. It summarizes the sampled data, relating sample variation to the various factors analyzed in the study. The wider perspective includes ordination.

Ordination is the arrangement of units in some order (Legendre & Legendre, 1998). It consists of plotting object points along an axis representing an ordered relationship, or forming a scatter diagram with two or more axes known to be of particular interest. Methods for ordination in reduced space also allow one to derive quantitative information on the quality of projections and study the relationship among descriptors as well as objects (Legendre & Legendre, 1998). Ordination in reduced space is often referred to as factor analysis since it is based on the extraction of the eigenvectors or factors of the association matrix (Legendre & Legendre, 1998). Examples of the commonly used ordination techniques include principal components analysis (PCA), principal coordinate analysis (PcoA), nonmetric multidimensional scaling (NMDS, MDS) and correspondence analysis (CA). For the purpose of this study, the principal components analysis (PCA) was used. PCA is an ordination

technique that reduces the number of variables in the data set by finding linear combinations of those variables that best explain most of the observed variability.

Due to the nature of the raw data, which had 3 different marking schemes for the 5 variables, the raw data was brought to a common marking scale by using the ranging method (Legendre & Legendre, 1998). The ranging method reduces the value of all variables (y'_I) to the interval [0, 1} by first subtracting the minimum observed for each variable (y_{min}) and then dividing by the range :

$$y'_i = y_I - y_{min} / y_{max} - y_{min}$$

In PCA, the data was plotted and interpreted using the distance biplot method. The main features of the distance biplots are as follows :

a. distances among the objects (students) in the biplots are approximations of their Euclidean distances in the multidimensional space
b. projecting an object (students) at right angle on a descriptor approximates the position of the object along the descriptor
c. the length of the projection of a descriptor in reduced space indicates how much it contributes to the formation of that space

PCA was performed using the CANOCO 4.0 software (ter Braak & Smilauer, 1998). The data set comprised of 5 variables, namely, students awareness, knowledge and attitude, students' reading or watching environmental habit and involvement in environmental activities measured from a total of 255 samples from both Melaka Tengah and Jasin.

A labeling system was established for the student samples collected. To identify the data set, each coordinate was given identification numerics. For example, the alphabet 'M' represented male students and 'F' represented female students. On the other hand, to identify students between forms, the number '1' represented form 1 students and the number '4' represented form 4 students. The numeric for location of school were 'U' for urban schools in Melaka Tengah while 'R' represented rural schools in Jasin.

xi. **Spearman's Rank Correlation Coefficient:** Correlation is a measure of the relation between two or more variables. The Spearman's rank correlation coefficient is a rank coefficient that provides nonparametric procedure for measuring the strength of the relationship between two variables. It is used when working with the ranking of individual values for the two variables. For the purpose of this study, the 2 variables are significantly correlated if the probability of obtaining an r-value (correlation coefficient) greater or smaller than 0 is less than 0.05.